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ABSTRACT

This report discusses some of the wide-ranging applications of computers and electronic networks now being used in all facets of teaching the English language arts. The report discusses examples of computer applications grouped into five roles: (1) tutors--computers individualize instruction, provide learning material at a controlled pace and record student progress; (2) tools--computers aid in reading, allow students to produce and format texts easily, facilitate revision of texts, and store all sorts of information for learners; (3) ways to explore language--computers make the regularities, beauties, and difficulties of language something that students can examine and interact with in new ways; (4) media--computers make possible new modes of communication; and (5) environments for communication--computers permit new forms of meaningful communication and reconfigure the relationships among students and teachers. (Forty-one references are attached.) (KEH)

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Technical Report No. 522

ROLES FOR COMPUTERS IN TEACHING THE ENGLISH LANGUAGE ARTS

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Abstract

New information technologies such as computers and electronic networks are now being used in all facets of teaching the English language arts. These wide-ranging applications raise the question: "What role should these technologies play in teaching and learning?" This report discusses examples of applications grouped into five roles: (a) tutor, (b) tool, (c) ways to explore language, (d) medium, and (e) learning environment.

ROLES FOR COMPUTERS IN TEACHING THE ENGLISH LANGUAGE ARTS

Computers and other new information technologies such as video, telecommunications, and speech synthesis, are playing increasingly more significant roles in English and language arts classrooms. Pervasive and multifaceted, information technology is beginning to mirror all the traditional topics, methods, and goals of teaching. Thus, research on its use in classrooms must consider a wide range of possible roles for the technology.

A narrow conception of computers' use within English language arts teaching today would see the computer as a device with some well-defined function, such as a drill on basic skills. Within this conception, it would make sense to examine critically the research that has been done specifically on computer use, with the aim of identifying the programs that are most effective and the populations of students who could most be helped. One would look for evidence of the effectiveness of this technique in comparison to other technologies, such as the use of film strips to learn about famous authors or playing word games as a way to build vocabulary.

A broader conception sees computers as flexible tools, which can be employed in such diverse ways that the basic question shifts from "Are computers good for English language arts?" to "How can computers be used to accomplish pedagogical goals?" or "How are computers being used?" Thus, rather than looking at technology as a new method to be assessed in toto, we must focus on the underlying educational issues first, and then ask what role technology can best play in each specific area. A computer program for teaching beginning reading that uses a phonics method would then be examined in relation to other approaches to teaching beginning reading, and only incidentally to other computer programs. This report presents five such roles for the computer.

Roles for the Computer

Computers are being used in classrooms for instruction in composition, literature, decoding, reading comprehension, spelling, vocabulary, grammar, usage, punctuation, capitalization, brainstorming, planning, reasoning, outlining, reference use, study skills, rhetoric, handwriting, drama, and virtually every other area of language arts. There are also programs specifically designed for preschool, primary, upper elementary, middle school, high school, and college students, as well as students in adult, English as a second language, foreign language, bilingual, and special needs classes.

These wide-ranging applications of technology raise the question, "What role *should* computers play in teaching and learning?" Some of the most important research on the use of computers in teaching English language arts has paralleled that of other research on computers in education in trying to answer this question. This work has been a process of discovery, and at times, of contention between rival camps. There are divergent conceptions regarding whether, why, and how computers should be used for instruction.

Turkle (1984) has suggested that computers act like Rorschach ink blots in the way they evoke diverse responses from people. She argues that these responses tell more about people than about computers. Similarly, the ways computers are used in schools reveal more about conceptions of learning than they do about what computers can or cannot do.

Below are some possible responses one might make to the question of how computers should be used (see also Dede, 1987; Taylor, 1980). Each is indexed, not simply to features of the technology, but to assumptions about the enterprise of schooling. Thus, depending upon one's assumptions about education, computers can be:

1. *Tutors*. They can individualize instruction, provide learning material at a controlled pace, and record student progress.

2. *Tools*. They aid in reading, allow students to produce and format texts easily, facilitate revision of texts, and check for spelling errors. They store in a compact and easily accessible form all sorts of information that learners need, from style sheets to encyclopedic data.

3. *Ways to explore language*. They make the regularities, the beauties, and the difficulties of language something that students can examine and interact with in new ways.

4. *Media*. They make possible new modes of communication and "hypertexts," or "hypermedia," which allow the intermixing of tables, charts, graphs, pictures, sounds, video, and text.

5. *Environments for communication*. They are a new social realm that permits new forms of meaningful communication and reconfigures the relationships among students and teachers.

It is not possible to present a survey of computer use within each of these roles that is both comprehensive and brief. Instead, this report presents some representative uses as a way of suggesting possible directions. Because computer use is still rapidly evolving, the examples represent categories of applications, not necessarily formal research studies on classroom effectiveness. There should be more such studies, for the few that exist highlight the diversity of the impact, positive and negative, that computers may have.

Computers as Tutors

Artificial intelligence research has led to the specification of criteria for "intelligent tutoring systems" (Neuwirth, 1989). An intelligent tutor should have the ability to perform the task being taught and to discuss it articulately. Thus, a spelling tutor should be able to correct misspellings and to identify them as instances of general spelling rules. A second important requirement is a representation of the student's evolving knowledge, so that misconceptions can be diagnosed and addressed appropriately. Third, the system should have strategies for teaching. It should know how to present material, how to pose problems, and how to achieve the appropriate balance between tutor-direction and support for student-directed inquiry.

Not surprisingly, designing an intelligent tutoring system for language use is difficult. Little such software exists today, and the most successful computer tutors have been designed for well-constrained topics within mathematics and science. One such program for language is *Iliad* (Bates & Wilson, 1982), which was designed to tutor deaf children who have difficulties mastering language forms such as negation and question formation (see Knapp, 1986, for a discussion of computer use for other special needs). *Iliad* can generate syntactic variations of a core sentence. For example, from the sentence "John ate the apple," *Iliad* might generate:

Did John eat the apple?
What did John eat?
Who ate the apple? etc.

The tutoring component asks the child to carry out similar transformations and comments on the result. *Iliad* could, in principle, be extended to allow children to design their own transformation rules, either using a simple grammar notation or by using examples. Thus, a child might propose: "Which apple did

John eat?" as a new transformation of "John ate the apple," and then test it on other sentences. The child would type "Mary sees the cat," and the system would use the rule to produce "Which cat did Mary see?" A related program is *VP*^{2} (Schuster, 1986), which tutors nonnative speakers in English. It incorporates an explicit model of the student's developing grammar.

Hundreds of tutoring programs exist that do not qualify as intelligent tutoring systems. These programs are designed to teach letters of the alphabet, spelling, vocabulary, synonyms and antonyms, grammar, punctuation, capitalization, and word usage. They are useful for developing skills in these areas, but extensive reliance on them may interfere with addressing a greater need: helping students to learn purposeful use of language in its complete forms (Warren & Rosebery, 1988).

Computers as Tools

Word processing (see Olds, 1985) has become such a commonplace fixture within English and language arts classrooms that some people now take it for granted, saying, "We only do word processing; when will we start real computer use?" Of course, word processing is real computer use, and serves an important function, even if it only helps with the practical details of creating and sharing texts within a classroom. Moreover, there is some, albeit mixed, evidence that in making it easier to compose and revise, to see problems with a text, and to share texts, students learn to be better writers and readers (Bruce & Rubin, in press; Collins & Summers, 1989; Daiute, 1985; Levin, Boruta, & Vasconcellos, 1982; Michaels & Bruce, 1988; Roblyer, Castine, & King, 1988; Rubin & Bruce, 1985, 1986; Wresch, 1984).

There are now hundreds of word processing program that allow writers to enter and revise text. Some, like *Bank Street Writer* (Scholastic), present menus of functions from which the author chooses, thus making it easy to learn and to use the system, but with some sacrifice of flexibility. More complex programs, such as *Wordbench* (Addison-Wesley) allow writers to control details of text format, permit access to indexed notes, and have capabilities for tables of contents, lists, footnotes and endnotes, bibliographies, and indexes.

Assistance in reading. But word processing is only one of the ways computers serve as tools for writing and reading (see Wresch, 1988). Programs with speech synthesizers, or stored speech, now assist readers who encounter unfamiliar words (McConkie & Zola, 1985; Rosegrant & Cooper, 1983). On-line dictionaries help with word meanings. Hypertext systems, which allow the storage of multiple, linked texts, can provide further explanations, additional examples, or commentaries on the text at hand, as the section on Computers as Media illustrates.

Generating ideas and planning. It is in the area of writing that we find the widest range of tool-like uses of computers. Several software programs have been designed to help with the tasks of planning and generating ideas (see Pea & Kurland, 1986). One program, called *CAC*, offers students advice on composing persuasive text. For instance, a student might ask for advice about choosing the next sentence. The computer suggests actions based on keywords it finds in the preceding text written by the student. Several word processing programs have an option to turn off the screen when text is being entered, so that the student is not distracted by the visual image of what is written. This technique is called "invisible writing" (see Marcus & Blau, 1983). It is one way of facilitating "free writing" (Elbow, 1973) and encourages students not to focus on editing prematurely. Idea generation activities are included in many other programs such as (a) *Seen* (H. Schwartz), a literature-oriented program; (b) *Writer's Helper* (Conduit), which displays the tree of ideas developed by the writer; (c) *Writing Workshop* (Milliken), which includes three prewriting programs; and (d) *Writing a Narrative* (MECC), a tutorial on narrative structure and point of view.

Computers also offer the capability of moving text around in various ways and of viewing it from different vantage points. For instance, outline generating programs such as *More* (Symantec) allow a

writer to build hierarchical structures for ideas. These programs have become known as "idea processors."

Finding information. Data bases of information make it possible for students to browse text as a method of stimulating their reading and writing. There are now large data bases available on compact disk. These include dictionaries (for instance, the *Oxford English Dictionary*), encyclopedias (for instance, *Grolier's*), and complete statistics from recent Olympic games. The NeXT computer comes with its own built-in library, including a thesaurus, a dictionary, and the *Oxford Complete Works of Shakespeare*. There are also many microcomputer-based data bases, such as Australia's *Bushrangers* (KnowWare), which allow students to explore new worlds of information.

Viewing a text. One program included in the *Writer's Workbench* (AT&T Bell Laboratories) strips away all text except headings and the beginning and end of paragraphs, giving the author an uncluttered view of text transitions. Similar features in *Writer's Assistant* (Interlearn) allow the user to see only the first sentence of each paragraph, or to flip between a sentence-by-sentence format and the conventional paragraph organization.

Seeing a text in which each sentence starts at the left margin makes it easier for writers to discover for themselves problems with capitalization, punctuation, run-on sentences, sentence fragments, repetitions, beginnings of sentences, and other technical points. The *Electronic English Handbook* (Technology Training Associates) provides a related sort of help: It is an on-screen reference tool that allows the writer to access usage rules and examples during the composition process.

Other programs exist to support composition within a genre, or discourse mode, such as poetry. These include poetry generators such as *Compupoem* (Marcus, 1982) and *Poetry Prompter* (Interlearn). Other programs help in analyzing or revising a poem. The *Poetry Processor* (Newman, 1986) aids the developing poet by displaying a line of a poem in a specified meter. For example, the first line of Shakespeare's Sonnet 18 (in iambic pentameter) would appear as:

> Shall I comPARE thee TO a SUMmer's DAY?

If a student wanted to try the same line in trochaic pentameter, the program would show:

> SHALL i COMpare THEE to A sumMER'S day?

After reading the line, the student might decide to rewrite the line or change the meter.

Writer's Workbench includes over 40 programs that provide feedback on spelling, diction, style, and other text characteristics. An interactive version of the program works within a text editor. It suggests correct spellings for words, and will automatically replace them if the author desires. The *Writer's Assistant* (Levin, Boruta, & Vasconcellos, 1982), checks spelling and other features, and allows students to try out various sentence combinations. *Epistle* (IBM) has a parser that detects complex linguistic problems, such as subject-verb agreement. The *Random House Electronic Thesaurus* provides word alternatives to facilitate revision. These programs are advisory, rather than tutorial.

Viewing the writing process. Despite extensive research on writing in recent years (Graves, 1982; Hillocks, 1986), we still know too little about how writers generate ideas, how they revise, how they use what they have read in writing, or how their writing changes over time. One reason is that such processes occur in the writer's head, and external manifestations, such as pauses, backtracking, use of resources, oral interactions with others, and so on, are difficult to record and interpret.

With text being produced and stored on the computer, there arise new possibilities for examining the writing process. Some text editors offer a "replay" facility, which re-enacts an entire editing session,

allowing student and teacher to see the process of text creation. Sirc (1989) describes how he uses this approach to model revision. He records every keystroke he makes during his revision of a student paper. Then he replays the revision session discussing the reasons for each step in the process. This approach allows students to peer inside the expert writer's process of revision.

Computers as Ways to Explore Language

Computer-based microworlds have been developed in various areas of science and mathematics to allow students to explore new domains, test hypotheses, construct models, and discover new phenomena (Papert, 1980). The same technology can be used to create microworlds for language. Investigations within these microworlds can be highly motivating for students. Moreover, they lead students to think deeply about language patterns, conceptual relationships, and the structure of ideas. We are only at the beginning of this potentially powerful role for computers in language instruction.

An example of this approach is the use of the programming language, *Logo*, to construct models of language structure and use (Goldenberg & Feurzeig, 1987). Students work within any genre, or mode of discourse, to build up their theories about meaning and form. For instance, they can write programs that gossip.

In this case, gossip is viewed as comprising descriptions of actions that someone else has allegedly taken, actions that are newsworthy because they involve surprising revelations about the other's character. Thus, there is a predication about a subject. In *Logo*, this might be expressed by the following procedure:

```
TO GOSSIP
   OUTPUT (SENTENCE PERSON DOESWHAT)
END
```

This procedure is a small computer program, which, when executed, produces a sentence composed of a first part, which is the name of a person, and a second part, which is a description of some action that person did. Now, this only works if the procedures, PERSON and DOESWHAT, are appropriately defined. For example:

```
TO PERSON
   OUTPUT PICK [SANDY DALE DANA CHRIS]
END

TO DOESWHAT
   OUTPUT PICK [CHEATS. [LOVES TO WALK.]-->
                    [TALKS A MILE A MINUTE.] YELLS.]
END
```

The first procedure, PERSON, selects one person from a list. The second procedure, DOESWHAT, selects a predicate to apply to that person. In this case, the predicate is expressed by an unanalyzed verb phrase. With these procedures, a student can then ask the computer to print out any number of gossip statements. At first, the interest for students comes from the fact that they can be playful, making the computer printout funny and sometimes surprising statements, even though they provided it with all its data. As they continue to explore the gossip domain, though, the interest comes from something deeper, a developing appreciation of the complexities, beauties, and regularities of language.

For example, students can revise the original procedures to produce more versatile GOSSIP programs. They can break apart the predication into transitive verbs with objects, or expand the range of possible subjects. They can add conditional actions to the procedures, for instance, that only certain people can

do particular actions. As they construct their GOSSIP programs, they are forced to confront fundamental questions about language, such as, "What is the relationship between syntax and semantics?" "What is a word?" or "What makes a sentence interesting?" While the program has no means for answering such questions, it provides an environment in which students can seek answers themselves; it allows them to see the consequences of their own hypotheses about language.

This approach is but one example drawn from a family of programs and activities designed to encourage students to explore language. *Phrasebooks* and *Boxes* (Sharples, 1985) are two extensions of *Logo* that allow children to classify words, create their own dictionaries and phrasebooks, devise a quiz, write a program that will converse in natural language, or build their own "Adventure Games," in which other students explore a student-created fantasy world. *Crossword Magic* (Mindscape) allows students to create crossword puzzles. The activity encourages exploration of word meanings and relationships, as well as spelling. *Missing Links* (Sunburst) supports activities in which students try to decipher a text in which various letters or words have been left out. In doing so, they develop reading and problem-solving skills. *Storymaker* (Rubin, 1980) allows students to create and manipulate text units larger than the sentence. Story structures are represented as a tree consisting of nodes connected by branches. The nodes contain sentences or paragraphs. The student creates a story by choosing branches to follow. The program adds each selected text segment to the story as the child moves through the story tree. The student can also write new text segments, which then become available for other students to choose. There is still little research regarding classroom use of these constructive approaches to language understanding (see Roblyer, et al., 1988).

Computers as Media

Increasingly, computer-based writing is not published as words on a printed page. Electronic mail, on-line documentation, and "electronic encyclopedias" are read directly from a video screen. The computer has thus become a new communications medium, one that facilitates traditional paper-based writing, but allows other forms of writing as well. There are now multimedia messaging and conferencing systems that allow users to send not just text, but images, graphics, spread sheets, voice and video, for example, *Diamond* (Thomas, Forsdick, Crowley, Robertson, Schaaf, Tomlinson, & Travers, 1985). These systems are being equipped with a variety of fonts to permit writing in languages such as Arabic, Russian, and Japanese. They can also display text in appropriate orientations, such as right-to-left or down a column. Research (Levy, 1988) is exploring how our current concepts of texts, documents, and media must change as these systems are used, and how to understand the possibilities for enhancing communication and exploring language.

Moreover, the computer can be used to create webs of related information (see Beeman, 1988). Explicit connections between texts allow readers to travel from one document to another or from one place within a document to another. The computer can help a reader to follow trails of cross-reference without losing the original context. Electronic document systems also facilitate co-authoring of text. A group of children can create a common electronic notebook by making their own contributions, viewing and editing one another's items, then linking the items together.

Authors and readers can now be given the same set of intergrated tools to create, browse through, and develop text. They can move through material created by other people, add their own links and annotations, and merge the material with their own writings. In consequence, the boundaries between author and reader may begin to disappear. Research is needed to understand these changes and the consequences they have for reading and writing instruction.

Several programs help writers organize thoughts using a tool described as linked note cards. *Notecards* (Xerox) includes a multiwindowed display that allows a writer to create individual notes that can be linked to other notes. Notes can contain graphic images or text. With the hypertext editing system IRIS (Brown University), a person reading an article about cars has a choice of how much detail to see about

the history of cars, their manufacture, their relation to the rubber industry, and so on. Hypertext has now become available on microcomputers (e.g., Apple's *Hypercard*). These systems open up new possibilities for communication. The challenge is to use this powerful medium in more open and enriching ways.

Computers as Learning Environments

Computers can be used to foster social interaction and thereby contribute to language development and learning (Handa, 1990). It is through feedback from others, peer tutoring, and sharing ideas that reading and writing skills develop. Several writing programs, such as the *Quill Mailbag* and *Library* (Rubin & Bruce, 1985, 1986) facilities, make it easier for writers to share their products. *Mailbag* is a simple electronic mail system in which writers can send messages to individuals (other students or the teacher), to groups, or to the whole class. *Library* allows texts to be stored with complete titles and authors' names and keywords to facilitate finding the text by selecting a topic. It allows students to store two authors' names with a text as a way of supporting collaborative writing.

Electronic networks are being used increasingly for communication among students and teachers. For example, the Computer Chronicles News Network allows children to share news items from around the world. Research is now underway (see Riel, 1988) to explore different ways of organizing such networks. Some networks are focused on a task; others have a looser conference structure. Some have centralized direction and others do not. It is too soon to say what the full implications of different network participant structures might be.

Teachers are also beginning to use electronic networks for communicating. In a project in Alaska (Bruce & Rubin, in press), teachers developed a community through the use of electronic mail. Their shared need to learn better ways of teaching for nonmainstream students was partially met through the exchange of classroom ideas and mutual encouragement over an electronic network. The network made exchange of messages much faster than ordinary mail and greatly eased the task of sending the same message to many people at once. Moreover, other writing already in electronic form, such as students' texts or a teacher's text written for a university course, could also be easily transmitted and shared with other teachers. There is now a *Computers and Composition Digest* used primarily in its electronic form. Teachers, researchers, and software developers interact through issues of the digest, which are constructed out of electronic mail messages and sent via networks to over 600 sites.

Research on using real-time communication networks to teach English language skills or composition is also underway, as in the ENFI consortium (Batson, 1988; Sirc, 1988; Thompson, 1987). In these systems, students engage in a written form of conversation. Their typed messages are transmitted immediately to others in the group. Such an environment requires students to formulate their ideas as written text but allows faster response than traditional writing or even electronic mail. Many students find these environments more conducive to writing than traditional writing classes.

Conclusion

Technology can be used to change writing instruction in a variety of ways. Computers can aid at places where teacher time and attention are insufficient. They can facilitate the processes of generating ideas and organizing text. Unlike teachers, they can give feedback at any convenient moment. They can comment upon features of written texts. With the aid of a text editor, revision of text is more efficient and rewarding. Computers can increase the time-on-task and can help lessen the teaching load. They can thus create time and opportunity for teacher involvement with essential aspects of writing processes that are beyond the reach of the computer.

New technologies can also help to realize a more functional way of teaching writing. Ideals of writing across the curriculum may become more feasible with the support of computers. By means of computer

networking, communities of student-writers can be established. Real audiences and meaningful goals can stimulate the development of competency in written communication as well as enhance motivation.

But the potential value of computers is far from full realization and there is a lack of research to validate the many claims being made. Many of the uses described here require a rethinking of student and teacher roles, of curricula, and of school activities. Moreover, current programs and models for computer-based activities are often clumsy to use or difficult to integrate with other learning. Costs are still high, especially when viewed as only a portion of the meager resources available for instructional materials. And too often, the best computer resources are inequitably distributed. Despite these problems, the use of computers for English language arts instruction is in fact growing and promises to be an increasingly important aspect of learning in the future.

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